Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: CH306

Course Name: MASS TRANSFER OPERATIONS-II (CH)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

1 a) State and explain Raoults law. Mention its applications. (3)

b) A solution containing CCl_4 and CS_2 in equal masses is to be continuously fractionated at the rate of 4000kg/h. The overhead product is to contain 95 weight% CS_2 and the residue 0.5 weight % CS_2. The feed will be 30 mole% vaporised before it enters the column. The total condenser is used, and reflux is returned to the column at bubble point. Equilibrium data (x,y mole fraction of CS_2) are as follows. (12)

T^0C	76.7	74.9	70.3	63.8	59.3	55.3	50.4	48.5	46.3
x	0	0.029	0.1106	0.2585	0.3908	0.5318	0.7574	0.8604	1.0
y	0	0.0823	0.266	0.495	0.634	0.747	0.878	0.932	1.0

i) Determine the product rates.

ii) Determine the minimum reflux ratio.

iii) Determine the number of theoretical plates if the reflux ratio is twice the minimum.

2 a) Explain the principles of flash distillation with a neat schematic sketch. (5)

b) A feed of 40 mole% hexane and 60 mole% octane is fed to a pipe still through a pressure reducing valve and then to flash disengaging chamber. The vapour and liquid leaving the chamber are assumed to be in equilibrium. If 60% of the feed is vaporised, find the composition of the top and bottom products. Equilibrium data for system is given below. (10)

Mole fraction of hexane in liquid (x)	1	0.69	0.4	0.192	0.045	0
Mole fraction of hexane in vapour (y)	1	0.932	0.78	0.538	0.1775	0

3 a) Liquid mixture containing 40 mole% methanol and 60 mole% water is fed to the differential distillation at atmospheric pressure with 60 mole% of the liquid is distilled .Find the composition of the composited Distillate and Residue (10)

Equilibrium Data

x	0.05	0.1	0.2	0.3	0.4	0.5
y	0.27	0.42	0.57	0.66	0.73	0.78

b) Derive Rayleigh equation for a binary mixture in distillation column (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) 1000 kg/hr of a water-dioxane solution containing 20% dioxane is to be continuously and counter currently extracted with benzene at 25°C to recover 80% dioxane. Water and benzene are essentially insoluble and the equilibrium distribution of dioxane between them are as follows: (10)

wt % of dioxane in water (100x)	5.1	18.9	25.2
wt % of dioxane in benzene (100y)	5.2	22.5	32.0

Determine the number of stages required if the solvent rate is 1.5 times the minimum benzene is used. Benzene is free from dioxane.

b) Explain selectivity and distribution coefficients with respect to liquid-liquid extraction. (5)

5 Explain the steps in finding the number of stages in a distillation column by Ponchon-Savarit method with neat sketches. (15)

6 a) A binary mixture of A and B containing 35 mol% A entering the column as saturated liquid is separated into a distillate containing 95 mol% A. It is specified that not more than 5% of A in the entering feed be lost in the residue. Assume that a total condenser is used. Feed is admitted at a rate 100 kmol/h. The enthalpy composition data are: (15)

x	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
H_L x 10^{-3} kJ/kmol	29.4	16.8	12.6	13.7	14.7	15.0	16.8	18.9	20.0	20.2	20.6
H_G x 10^{-3} kJ/kmol	244	248	252	254	250	242	229	210	193	168	141

The equilibrium data (mole fraction of A) are:

x	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
y	0	0.275	0.45	0.56	0.685	0.775	0.85	0.90	0.945	0.98	1

Determine:

(i) The minimum reflux ratio.

(ii) The number of ideal plates at twice the minimum reflux.

(iii) The condenser and reboiler heat duties.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Crushed oil seeds containing 55% oil by weight are to be extracted at the rate of 4000kg/h using 6000kg/h of hexane containing 5% oil by weight as the solvent .A counter current two stage extraction system is used. The oil seeds retain 1kg of solution per kg of oil free cake. Calculate the percent recovery of oil (based on feed) obtained under the above conditions. (20)

8 a) Explain with a neat diagram the principle and working of mixer-settler cascades. (10)

b) Explain with a neat diagram the principle and working of sieve plate column. (10)

9 a) Under what conditions the constant underflow and variable underflow conditions occur in leaching? (10)

b) Explain in detail about the factors affecting the rate of leaching operation. (6)

c) In representing leaching equilibrium is it essential that the tie lines are always vertical. Substantiate your answer. (4)

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